DISCUSSION OF THE AMENDMENT

Claims 1-2, 4, 7-13, 18-19, 26, 28-29 and 31 are active in the present application. Claims 3, 5-6, 14-17, 20-25, 27 and 30 are canceled claims. Claims 8-11 are presently withdrawn from prosecution.

No new matter is added.

REMARKS

Present Claim 1 is drawn to a silica glass crucible used for pulling silicon single crystal that includes a silica glass crucible and a graphite susceptor. An outer surface of the silica glass crucible is covered with fine grooves having the dimensions recited in Claim 1. The outer surface of the crucible has projections having a height of 0.1 mm or more in an amount of less than $5/mm^2$.

Applicants demonstrate the criticality of including grooves on a silica glass crucible in the examples of the present specification. The results of the examples are presented in Table 1 on page 10 of the specification, reproduced below for convenience.

	Frictional Coefficient with Graphite	Frictional Coefficient with C/C Material
Sand-blast Treated Sample	0.8 (40°)	1.2 (50°)
No Sand-blast Treated Sample	0.4 (20°)	0.5 (25°)

(Note) The value in a parenthesis is an angle of inclination.

The sand-blast treated sample has a surface that is grooved according to the claims. The inventive example has a substantially increased coefficient of friction in comparison to a silica crucible that does not have the grooves of Claim 1.

As stated in the present specification:

> The sample pieces carried out the treatment of the present invention had about twice frictional coefficient to the both of the graphite material and the C/C material as compared with that of the comparison pieces.

See the last sentence on page 9 of the specification.

The Office asserts that the presently claimed invention is obvious over Sarno (U.S. 4,403,955) in combination with Hill (U.S. 2,947,114). It appears that the Office has taken the position that Sarno's disclosure of a glass crucible having a rough outer surface renders obvious a silica glass crucible having the groove features recited in the present claims. Applicants traverse the rejection for the reason that the Office failed to set forth a *prima facie* case of obviousness.

The Office cites to Sarno as evidence that a device made of an inner silica glass crucible (e.g., an "inner member") and an outer graphite crucible receptacle (e.g., an "outer member") was known in the art prior to Applicants' invention. The Office appears to believe that Sarno's disclosure of an inner silica member having a rough surface is evidence that surface roughness is a result effective variable with respect to obtaining an improved silica glass crucible (see pages 3 and 4 of the September 17 Office Action). Applicants submit the Office mischaracterizes the disclosure of Sarno.

In fact, Sarno discloses a crucible receptacle (e.g., what the Office characterizes as a graphite susceptor) that has a segmented structure. Sarno discloses:

> A crucible receptacle is provided that is adapted for complete contact support of a melt containing crucible, which may be in a softened state, wherein the improved receptacle comprises a segmented cup-shaped receptacle for completely supporting the softened crucible. The receptacle has a plurality of similar separate rigid elevational segments, the sides of which are normally adjoining, but are separable upon cooling to relieve thermal stresses due to different coefficients of expansion of a quartz crucible and the graphite receptacle.

See column 1, lines 46-55 of Sarno.

The segmented nature of the Sarno crucible receptacle is shown in Figure 1 (reproduced below) where reference no. 11 indicates portions of the crucible receptacle that are segmented, i.e., the walls of the crucible receptacle are cut such that segments are formed therein.

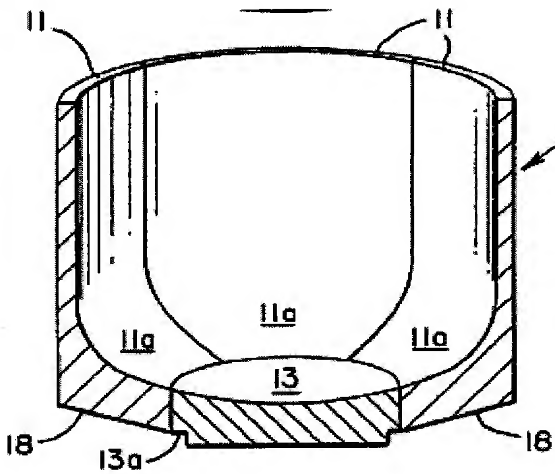


FIG. 1

The individual segments of the Sarno crucible receptacle are capable of moving independently of one another:

> The segments are thus normally adjoining, but are not secured together, to permit separation of segments to relieve stresses in cooling.

See column 2, lines 8-10 of Sarno.

During heating the Sarno silica glass crucible slides against the segments of the Sarno crucible receptacle. Sarno discloses:

> With the elevational support of the quartz crucible 12 being formed in three or more segments 11 of the receptacle 10, together with a bottom annular segment 13, as the graphite receptacle 10 cools at the end of the crystal growth run of the furnace, the pressure due to contraction of the receptacle 10 at a higher rate than the crucible 12, is alleviated by outward movement of the segments 11. The bottom surface 18 of each of the elevational segments 11 and the top surface 17 of the unitary base plate 14 are at an angle of about 15° to the horizontal to permit the segments to slide outwardly and upwardly, as cooling takes place, to relieve stresses which would otherwise break the graphite receptacle 10.

See column 3, lines 5-17 of Sarno.

As demonstrated in the above-quoted disclosure of Sarno, the prior art article includes a segmented crucible receptacle that has segments which slide against the quartz crucible. This mode of functioning is contradictory to the Office's assertion that one of skill in the art would be motivated to roughen the surface of a quartz crucible. Applicants submit that those

of skill in the art would recognize that such roughening would make sliding between the quartz crucible and the crucible receptacle more difficult.

Thus, contrary to the Office's assertion, roughening the surface of the Sarno quartz crucible would not provide a device that is superior to a device wherein the inner quartz crucible has a relatively smoother surface.

Sarno further discloses the following with respect to the roughness of the quartz crucible:

> The segmented receptacle 10 can have its segments 11 adjusted to accommodate any roughness, or unevenness of the crucible 12 without creating stress points that may cause breakage of both the crucible 12 and the receptacle 10 during a normal melt process in growing crystals.

See column 3, lines 36-41 of Sarno.

The above-quoted disclosure of Sarno shows that the cited reference is designed in a manner to "accommodate any roughness, or unevenness of the crucible ... without creating stress points". Applicants submit that this description of the Sarno patent does not constitute any suggestion that such roughness can be optimized to improve adhesion between the quartz crucible and a crucible receptacle. In fact, to the contrary, the above-quoted disclosure makes it clear that the crucible receptacle can be engineered in a manner to produce segments such that adhesion between the crucible and the crucible receptacle is eliminated and the segments slide against the quartz crucible to relieve stress between the two.

Sliding is the opposite of adhesion. The Office's assertion that it would be obvious to optimize the surface roughness of the Sarno quartz crucible to obtain improved adhesion between the quartz crucible and the crucible receptacle is contrary to the evidence of record.

Sarno therefore teaches away from optimizing surface roughness to obtain a silica crucible having high adhesion between a silica crucible and a graphite receptor.

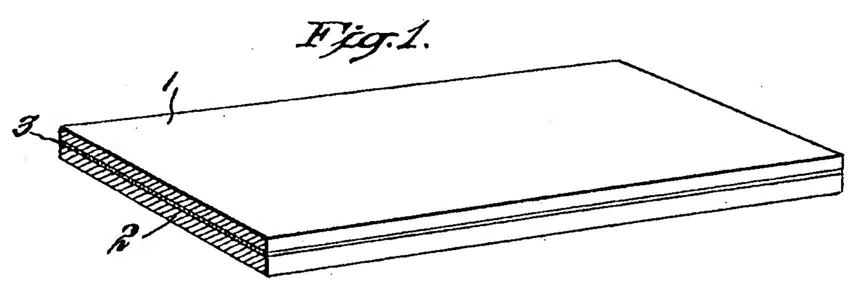
The Office appears to rely on Hill as a teaching that one of ordinary skill in the art would be motivated to modify the Sarno crucible with a roughened surface to improve adhesion between the Sarno crucible receptacle and quartz crucible. The basis for the Office's reliance on Hill is contradictory to the explicit disclosure of the reference.

First, Hill discloses an article that is different from the presently claimed silica glass crucible. In fact, Hill expressly excludes crucibles that are made of silica. The Office nonetheless asserts that one of skill in the art would apply the teachings of Hill to the article of Sarno. Applicants submit that such an assertion is legally unsupportable and the combination of Hill and Sarno is improper.

With respect to Hill's teaching that silica is excluded from the Hill device, Applicants draw the Office's attention to the following disclosure:

> Referring to Figure 1, the composite material comprises a layer 1 of noble metals such as a platinum group metal, e.g., platinum, or gold or silver and including alloys of such noble metals, and a base metal layer 2 such as a layer of nickel, brass, stainless steel, inconel, etc.; with a barrier layer 3 therebetween. Specifically, the barrier layer is composed of a refractory oxide in diffused state, said refractory oxide being preferably selected from the group consisting of fused alumina and zirconia **substantially free of silicon compounds**. By **"substantially free of silica compounds"** it is intended that the refractory oxide in the applied fused state **contains less than one percent of silicon compounds, e.g., silica,** with the said preferred oxide constituting at least 99% by weight of the total oxide composition.

See column 2, lines 17-31 of Hill. For convenience, Figure 1 of Hill is reproduced below.



It is incontrovertible that Hill excludes silica glass from the Hill article. It is inconceivable how the Office can combine Hill with Sarno as evidence that one of skill in the art would be motivated to modify the silica surface of Sarno according to the teachings of Hill in view of the fact that Hill explicitly excludes silica glass.

The combination of Hill and Sarno is therefore unsupportable.

Further still, the Hill composite material is a three layer article having two outside layers of metals (i.e., reference numerals 1 and 2 in Figure 1 above) and an inside layer of a non-silica, i.e., non-quartz, intermediate layer (i.e., reference numeral 3) sandwiched between the outer layers of metal. The Office failed to explain why one of ordinary skill in the art would turn to such a structure as inspiration to modify the outer surface of the Sarno quartz crucible.

Applicants submit that it is readily recognized by those of ordinary skill in the art that metals such as the metals that are used to make the outer layers of the Hill composite material have substantially different properties than quartz and silica glass. Such differences include brittleness, hardness, thermal conductivity, melting point, coefficient of expansion, *etc.* It is immaterial and irrelevant to the patentability of the presently claimed invention that Hill discloses modifying the surface of a metal material. The roughened surface of the Hill composite material is entirely different from the surface of the silica crucible of the present claims and the quartz crucible of Sarno.

In the absence of any evidence that one of ordinary skill in the art would believe that it would be possible to substitute the metal layers of Hill for the quartz crucible of Sarno, the Office's assertions of obviousness are not supportable and should be withdrawn.

The rejection should be withdrawn for the following additional reasons. Silica glass crucibles for use in pulling up a single crystal silicon have conventionally been produced by

heating and fusing a layer of quartz powder provided in the inner surface of a mold and subsequently vitrifying the quartz. In that state, unmelted quartz powder is adhered to the outer surface of the silica glass crucible.

Even after removing the unmelted quartz powder by high-pressure water, numerous projections having a height of ca. 0.1 mm or more remain on the outer surface of the silica glass crucible, thus deteriorating the ability of the crucible to adhere to the carbon susceptor.

Claim 1 describes surface properties of a silica glass crucible wherein the unsatisfactory surface state such conventionally produced crucibles is improved. Fine groves are formed on the outer surface of the wall part of the silica glass crucible while at the same time the number of projections are reduced. The resulting crucible exhibits enhanced adhesion to the graphite susceptor. This property is reflected in the presently claimed invention by the recitation of certain surface projection density and sliding frictional coefficient requirements. By such a property, the silica glass crucible of the present application has excellent adhesibility to the susceptor and deformation of the crucible at high temperature state can be prevented. As shown in Table 1 of the present application, conventionally produced crucibles have a low frictional coefficient between silica glass crucible and graphite before sand-blast treatment.

On the other hand, Sarno describes a surface state wherein unfused silica sand remains on the outside surface of the crucible (column 3, lines 27-35). That is, Sarno describes a surface state before performing the surface treatment to achieve the surface properties described in Claim 1.

The Office asserts that it would have been obvious to one of ordinary skill in the art to provide Sarno's crucible with a roughened surface as taught by the Hill to provide a crucible having improved adhesion between inner and the outer member.

However, Hill fails to describe smoothing of surface by decreasing a density of surface projections. The constraints on the average number of surface projections per unit area and the sliding coefficient described in Claim 1 are achieved by an effort to smooth (not roughen) the surface of the crucible. Therefore, such properties cannot be achieved by a routine experiment with an intention to roughen the surface of the crucible.

On the other hand, the fine grooves having a predetermined width have a role to enhance the adhesivity to a susceptor, where the susceptor includes carbon fibers. Such a property cannot be formed by mere intention to roughen the surface.

The rejections should thus further be withdrawn because the combination of references relied on by the Office fails to lead one of skill in the art to the solution disclosed by Applicant in the present application.

The Office Action of September 17 further cites to Tsuji (U.S. 6,524,668) "as evidence" (see page 4 of the September 17 Office Action). It is unclear for what purpose the Office cites to Tsuji in the Office Action. The Office fails to relate the Tsuji article to the features of the presently claimed invention.

Applicants submit that Tsuji in no way supports the rejection of the present claims as obvious over the combination of Sarno and Hill, or Sarno, Hill and Tsuji. Tsuji does not support an assertion that the surface roughness of a silica glass crucible is an optimizable feature such that improved adhesion between a crucible and a graphite susceptor may be obtained.

The Tsuji composite crucible has a carbonaceous material outer layer and a quartz glass inner layer that is "integrally formed" with the carbonaceous material. Such integral formation involves melting, e.g., fusing, quartz glass powder deposited on the inside of the carbonaceous material (see the description of the manner in which the Tsuji composite crucible is made in columns 2 and 5 of the Tsuji patent). The Office fails to provide any

explanation how the outer surface of the inner quartz material of the Tsuji composite crucible can be modified with respect to roughness. Because the inner quartz glass of Tsuji is essentially melted into the carbonaceous material there is no way for it to be modified subsequent to its integral formation.

Moreover, Tsuji discloses that the roughness of the resulting inner quartz layer is defined by a certain average roughness and other features (see column 2, lines 32-41 and column 4, lines 6-12). For example, Tsuji discloses:

> In concrete terms, it is appropriate that an average roughness (an arithmetic average roughness) of the surface jointed with the quartz glass of the inner layer being 0.1-1.0 mm and that an average distance of concave and convex parts being 0.2-5 mm.

See column 4, lines 6-10 of Tsuji.

The Office fails to relate the average roughness features of the inner layer of the Tsuji composite crucible with the features recited in the present claims. As already mentioned above, the present claims recite a crucible having an outer surface covered with fine grooves of certain dimensions. The dimensions include a depth of 3-30 μm. The Office provides no basis for asserting that such features are in any way suggested by an average roughness of 0.1-1.0 mm (the Office should note that the micron-level features of the grooves of the present claims are substantially different in size than the average roughness provided in millimeters of Tsuji, i.e., 1 μm = 0.001 mm). Further in this regard, the present claims recite a restriction with respect to the number of projections having a height of more than 0.1 mm.

The Office fails to provide any nexus between the disclosure of Tsuji and the presently claimed invention. Applicants submit that the Office's reliance on Tsuji makes no sense and is improper for the reasons mentioned above.

For all the reasons discussed above in detail, Applicants submit the rejection of the present claims is not supportable and should be withdrawn.

INFORMATION DISCLOSURE STATEMENT

Applicants submitted an IDS in the present application on September 12, 2008. The Form PTO-1449 submitted therewith listed four foreign patent documents as references AO-AR. Applicants submit herewith an electronic acknowledgment receipt showing that Applicants timely filed the IDS of September 12, 2008 together with copies of the cited foreign references.

The Office indicates on page 2 of the September 17, 2008 Office Action that the foreign references were not filed. Applicants submit the attached electronic acknowledgement receipt evidences the timely filing of the foreign references cited on PTO Form -1449.

For the Office's convenience, Applicants submit herewith copies of the four foreign references submitted on September 12.

Respectfully submitted,

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